



# Canada: The Future of Photonics

Tracey Ford  
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## Summary

U.S. companies who offer core photonics technologies will find a receptive market in Canada for their products as Canada no longer has domestic sources of core photonics technologies. U.S. companies may also find many opportunities to enter the Canadian Photonics market through cooperation at the business level on photonics research and development. This report describes the photonics market in Canada, one of the most advanced photonics sectors in the world, and how U.S. businesses can enter and succeed in that market.

## Market Demand

Photonics is defined as the control and manipulation of light for the purposes of acquiring, processing and storing of data. Traditionally known as a critical enabling technology, photonics had its beginnings in Canada in the telecommunications sector. In fact, Canada has been a pioneer in photonics since the very inception of the field. Canada has a long tradition of ground-breaking excellence in photonics stemming from decades of research performed in university and government laboratories. Canada has paved the way for innovative technologies including:

- the solid state laser range finder,
- the fiber Bragg Grating,
- charge-couples devices (CCDs),
- the first open-heart surgery using an excimer laser,
- photodynamic drug therapy for cancer treatment,
- the commercial 10 Gbit/s optical transport and
- the first laser radar system on the surface of Mars.

Many people attribute the success of the photonics industry in Canada to earlier investments by two large industrial anchors, Nortel Networks, and JDS Uniphase. In 2000, Nortel accounted for over 50 percent of the global revenues for optical network equipment while JDS Uniphase dominated the global market for optical components. When the tech 'bubble' burst later that same year, many photonics companies were forced to close their doors while others were faced with significant cutbacks and layoffs. There was significant backlash against 'photonics' because at that time, many people identified photonics as being solely about fibre-optic communications.

Since the IT downfall in 2000, the photonics industry landscape in Canada has changed with major players reducing their presence and the remaining community of small and medium-sized enterprises becoming far more focused on the growing fields of non-telecom applications for photonics technologies. Today, photonics underpins many key sectors in Canada including health, communications, security and the environment and while some of these applications would be considered mature (e.g. optical photonics), others (e.g. biophotonics) are just emerging.

Canada is still considered a leader in the field of photonics, especially in the field of research and development. This is largely due to the fact that the photonics sector is strongly supported by all three levels of government; federal, provincial and municipal. The Government of Canada (GOC) has named photonics as one of the upcoming and strategic important sectors to the country. This has been demonstrated by the amount of money the GOC has expended on photonics. Canada spends approximately \$150 million annually of federal and provincial government money on broad photonics-related research. Beneficiaries include universities, government laboratories and some support for corporate R&D. In early 2008, as part of a \$118 million investment in the [National Research Centre \(NRC\)](#) facilities across Canada aimed at helping to foster the growth of small technology companies, the Canadian Federal government granted \$22.3 million to the [Canadian Photonics Fabrication Centre](#). This money was intended to be used to help the NRC work with businesses and universities to help create new commercial technologies and educate future generations of researchers.

The strength of the photonics industry in Canada comes from the 'Photonic Corridor,' which is the area between Quebec City – Montreal – Ottawa. This corridor hosts numerous significant photonics clusters, photonics associations and government research and development laboratories. Some of the more notable associations are listed below.

[Canadian Photonics Consortium \(CPC\)](#) – Founded in 2000, the consortium is primarily a coordinating entity between the regional clusters and other photonics organizations. The CPC also undertakes activities such as organizing the Canadian pavilions at major trade shows, the organization of the annual conference, Photonics North, international partnering events and industry research.

[Canadian Photonics Fabrication Centre \(CPFC\)](#) – A division of the NRC, the CPFC is a national technology centre offering a comprehensive suite of commercial grade foundry services in both III-V semiconductor and silicon-based materials for organizations interested in developing leading-edge photonic devices.

[Communications Research Centre \(CRC\)](#) – An agency of Industry Canada, CRC is the federal government's main facility for communications R&D. The CRC's optoelectronics and photonics research program develops components which increase the capacity, versatility and performance of fibre optic broadband networks.

[CMC Microsystems](#) - builds partnerships between government, industry and universities to enable and accelerate Canadian competitiveness in microsystems technology.

[The Institut National d'Optique \(INO\)](#), based in Quebec, is Canada's largest optics research centre and ranks among the largest in North America. Its primary stated mission is to facilitate research transfers to companies. In association with the nearby Universite Laval, new research programs create applications such as micro-optics, vision, coatings, specialty fibres and laser machining.

[National Research Council of Canada \(NRC\)](#) – The NRC is Canada's leading organization for scientific research and development. It is comprised of a number of institutes that specialize in various areas. Those pertaining to photonics include:

- The Institute for Microstructural Sciences (IMS)
- The Steacie Institute for Molecular Sciences (SIMS)
- The Institute for Biodiagnostics (IBD)
- The Biotechnology Research Institute (BRI)
- The Industrial Materials Institute (IMI)
- The National Institute for Nanotechnology (NINT)

Many of these institutes partner globally with industry, educational institutions, government departments and agencies to deliver industrially relevant research and development and to open new market opportunities.

## Market Data

It is very difficult to measure the dollar value of photonics as an industry because there is no clear-cut definition of a 'photonics company'. Also, photonics has so many applications that a photonics company could include anything from companies who manufacture photonics components or subsystems to companies who use photonics to create other primary products or services. Therefore, in this section, a photonics company refers to a company or division of a large company whose product relies primarily on photonics.

A recent report released by the Canadian Photonics Consortium (CPC) says that photonics components and photonics-enabled products are a \$710 billion global industry that impacts every sector of the economy and the daily lives of every Canadian. The results of the report show that the annual growth rate of this industry is about 14 percent and the CPC says that photonics is well on its way to becoming a \$1 trillion industry by the early part of the next decade, even considering the recent downturn in the world economy.

Canada has about 400 photonics companies which employ approximately 20,000 people. Collectively, these companies generate close to \$4.5 billion annually. Approximately 85 percent of these revenues are generated from exports, with half coming from the United States. The Canadian photonics industry is also quite dependent on foreign imports with the majority coming from the United States, Japan and Germany. Approximately 50 percent of all photonics imports into Canada come from the United States.

The majority of Canadian photonics companies lie in the Photonics Corridor between Quebec City and Ottawa. This is the area that has traditionally shown strength in photonics in Canada. However, there are a growing number of companies starting throughout the Prairie Provinces and British Columbia.

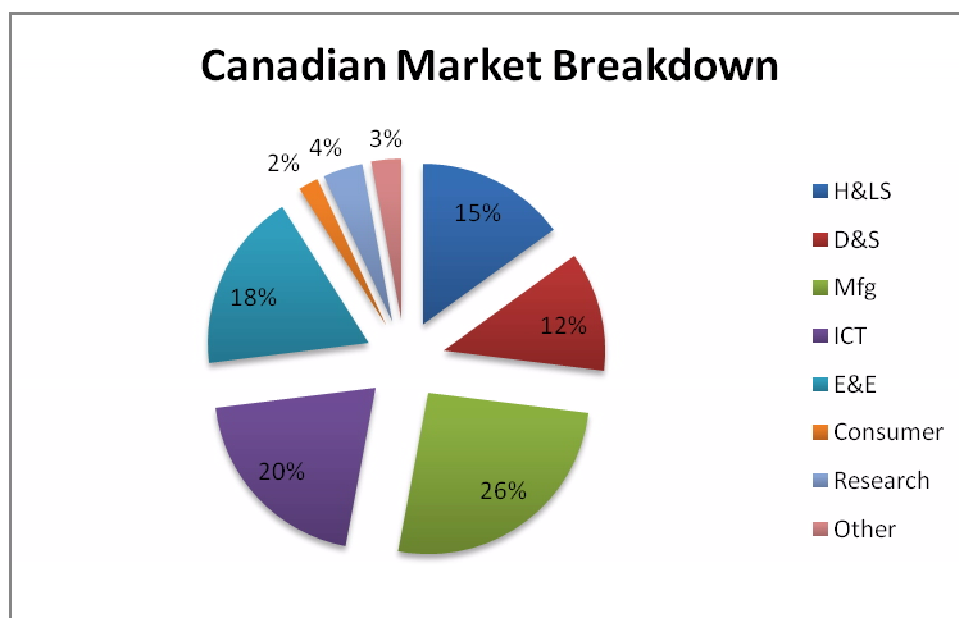
	Companies	Employees	Revenues
<b>Ontario</b>	117	10,200	\$3.0B
<b>Quebec</b>	104	4,750	\$600M
<b>Prairies</b>	95	2,990	\$330M
<b>British Columbia</b>	50	2,010	\$430M
<b>Atlantic</b>	8	310	\$36M
<b>TOTAL</b>	<b>374</b>	<b>20,260</b>	<b>\$4.4B</b>

Canadian Photonics Consortium Report, 'Making Light Work for Canada'. December 2009

Canada's photonics producing sector is firmly rooted in small and medium sized enterprises (SMEs) and startups, with revenues in the \$1-10 million, although there are a handful of larger companies or divisions. The [Canadian Photonics Consortium](#) has identified that the majority of these companies (65 percent) provide subsystems or systems and instruments as their end product. As Canada no longer has major laser manufacturers or volume components manufacturers almost all of these products use imported optical components to which the company adds electronics, firmware and software to address a particular application. The remaining companies range from developers and components manufacturers to complete photonics-based instrument manufacturers (cameras, projectors, scanning microscopes).

The range of products produced by Canadian companies is wide. For example, solid-state lighting assemblies, remote gas analyzers, manufacturing inspection equipment and optical testing equipment. There are a few companies who provide photonics-based services, such as leak detection and monitoring. For all companies, the focus is on value-added products.

Five years after the telecom downturn, the photonics industry in Canada has clearly diversified. Fewer than 20 percent of companies now claim to address the communications sector, and only 15 percent address the defense and security sectors – historically the two main pillars of Canada's photonics community. The graph below identifies the percentage of photonics companies in each business sector in Canada.



Canadian Photonics Consortium Report, 'Making Light Work for Canada'. December 2009

The photonics industry is well-established in both Ontario and Quebec. There is a strong focus on traditional photonics markets such as defense and telecoms, but an emerging focus is on sensing (Quebec) and life sciences (Ontario).

Both provinces have mature industry clusters that network with each other. They have well-funded and internationally respected university groups such as McGill, Laval, Ottawa, McMaster and Toronto; and they have major government facilities such as the [NRC](#), [CRC](#), and [INO](#) that are successful at technology transfer and company incubation. They also benefit from provincial governments that have encouraged and invested in photonics over many years.

In Western Canada, where these benefits have not been strongly present, the economic activity in photonics is more diverse. There are few large companies, no major government facilities specializing in photonics, fewer university groups and no formal networking of photonics interests. In these provinces, much of the activity takes place in SMEs or startups that appear to have little interaction with each other. Clusters of activity are emerging in the Edmonton (oil and gas exploration) and Vancouver areas (lighting). The National Research Council's newly established [National Institute of Nanotechnology \(NINT\)](#) in Edmonton is a strong beginning to photonics research in the western provinces. In addition, a current proposal to establish a fusion facility in Alberta would create a significant cluster of expertise in high-power lasers. In the future, strong clusters may be created around both Edmonton and Vancouver.

## Best Prospects

Many Canadian companies are leaders in photonics innovation because of a developed research infrastructure. This research has led to a vast breadth of intellectual property across many photonics-related areas. Specifically, Canada has niche expertise in areas such as image sensors and vision systems, telecommunications, biometrics and biophotonics.

Despite the high investment in photonics research and development that is undertaken in Canada, technology flow and transfer between the academic and industrial sectors is inadequate and many technologies are not

finding their way to the marketplace. For this reason, there has been a long tradition for Canadian companies, universities and research institutes to partner with foreign firms.

The photonics industry also presents opportunities for two other types of U.S. exporters:

- (i) suppliers for photonics companies and
- (ii) photonic companies offering equipment and services.

U.S. companies who fall into these two categories should recognize Canada's strengths and gear their market entry strategies to areas where there is a need. For example, Canada has no domestic sources of many key photonics components, including lasers and LEDs. Canada also imports much of their optical fibre, especially specialty fibres, instrumentation and wafer & chip fabrication. Described below are specific industry sectors and areas where U.S. exporters may find markets in Canada.

### **Defence and Security (D&S)**

Even though Canada now only plays a small role in defense photonics, which is primarily at the enabling-science level, it has demonstrated leadership in niche areas of the core technologies in selected photonics-based systems and applications. This includes remote imaging, visualization, simulation, remote sensing and displays. Still Canada has no domestic suppliers of the basic components required for these systems. Canada's small domestic market also means that most of the products and services produced in the area are exported from the country.

Canada also has a unique advantage to other countries in that it shares a common border with the United States and therefore researchers and producers on both sides of the border share common challenges. As a result, most major U.S. defense and security companies have an active presence in Canada.

### **Energy and Environment (E&E)**

Canadians are, on the whole, environmentally-conscious people. There is a great demand for green technologies, especially given the social and governmental pressures to monitor pollutants. Canadian companies are beginning to excel in areas such as the production of solar grade silicon, lighting, solar energy and monitoring and measuring technologies. The majority of Canadian companies operating in this sector are system or subsystem integrators that use optical components imported from the United States, Europe and Asia.

### **Health Care and Life Sciences (H&LS)**

Canada has a number of small companies that develop photonics-based components, techniques and instruments for use in health sciences. These companies have not been successful in commercializing their products because Canada does not have enough large companies capable of taking the products to market. As a result, technology that is commercialized is usually done through U.S. companies. As an example, Canada is a world leader in the development of optical coherence tomography, instrumentation for sub-micron imaging of large tissue specimens in fluorescence and brightfield and photodynamic therapy but has not been able to commercialize these products.

### **Information and Communications Technologies (ICT)**

As Canada continues to recover from the telecom meltdown of the early 2000's, the ICT sector is smaller but still has a significant presence, especially in Ontario. The deregulation of the telecommunications industry, the widespread introduction of high-capacity optical fibre and the popularity of the Internet has prompted increased competition in the Canadian telecommunications industry. Business trends in Canada for the ICT industry include extending Fibre to the Home (FTTH) or Fibre to the Neighborhood (FTTN), implementing HD Video on demand, increasing bandwidth and customer-managed networks. The demand for U.S. exports in this sector has increased as a result of the growing demand by Canadian companies for new, faster, cheaper technologies.

### **Manufacturing**

Although Canada maintains a strong position in the manufacture of imaging and vision equipment, it is primarily an end user of photonics products for manufacturing. Many Canadian companies already employ

photonic technologies as they believe that manufacturing processes will increasingly be based on photonics. Trends in this area include optical quality control, optical test and measurement, optical micro and nano processing and machine vision. Canada does not have domestic sources of many photonics components, such as lasers and LEDs, or semiconductor manufacturing capabilities. Also, product identification (laser marking), which is a market worth approximately \$60 million per year, is almost entirely provided by foreign suppliers. U.S. companies who manufacture these types of products will find a market in Canada.

## Key Suppliers

There are many supplier of photonics equipment in Canada. Examples of the larger firms selling photonics products in Canada are listed below. A more exhaustive list can be obtained by contacting the U.S. Commercial Service in Ottawa.

### Domestic Companies:

[Dalsa Corporation](#)

[QLT Inc.](#)

[Neptec](#)

[XYZ RGB](#)

[Boreal Laser Inc.](#)

[fSona Systems](#)

[EXFO](#)

### Foreign Companies:

[Agilent Technologies](#) – Germany

[BAE Systems](#) – U.S.

[Carl Zeiss](#) – Germany

[Hamamatsu Photonics](#) – Japan

[IPG Photonics Corp.](#) – U.S.

[JDS Uniphase](#) – U.S.

[Leica](#) - Germany

[Melles Griot](#) – U.S.

## Prospective Buyers

Because of the gradual, stable growth anticipated for the Canadian photonics market, this is an excellent time for U.S. companies with new and innovative technologies to enter all segments of the market. Currently, significant research and development is under way in the area of photonic networks with an emphasis on super-high-speed photonic processing, optical packet switching technology, medical technologies, biophotonics and nana-photonics. Canada's private sector is dominated by small and medium-sized enterprises that are looking for partners to share risks and investment, allowing them to take full advantage of opportunities that could make them key international players.

Although Canada's photonics industry is growing rapidly, the market is still dependent on foreign products. As mentioned above, most of Canada's photonics producing sector is small and medium sized companies and startups with a few larger companies. The majority of these companies provide subsystems or systems and instruments as their end product. Because Canada doesn't have major laser manufacturers or volume components manufacturers, almost all of these products use imported optical components. The remaining companies range from developers and components manufacturers to complete photonics-based instrument manufacturers (cameras, projectors, scanning microscopes) who import almost all raw materials for the manufacture of their products.



Some U.S.-based firms have moved part of their operations to Ontario to take advantage of R&D tax credits. There has also been an increase in the number of formal research collaborations among industry, university-based researchers and NRC research teams on themes of national importance such as energy, environment and health. However strong Canada is in the research and development of innovative photonics products, often times they are unable to take these products to market because of lack of funding or the lack of large commercial companies in Canada.

For U.S. companies who have patented technologies, components and devices particularly suited for these areas, there may be opportunities to partner with Canadian companies, transfer technology or jointly commercialize products.

## **Market Entry**

Canada is an ideal export destination for U.S. businesses. It is geographically close to the U.S. and shares similar business practices and attitudes. More importantly, Canadian companies are predisposed to partnering with U.S. firms. The integration of trade and investment between Canada and the U.S. has vastly simplified doing business across our common border. U.S. products and services also experience a high degree of receptivity in the Canadian market.

Canada's distribution and sales channels for photonics equipment are similar to those in other industrialized countries. For U.S. firms, there are various ways to enter the Canadian market. Your market entry strategy should be based on your knowledge of the Canadian market, financial resources and human capital available. Entering the Canadian market can be accomplished by establishing partnerships, joint ventures, subsidiaries or opening an office in Canada, but for the initial stage it is often preferable to work with local agents or representatives in order to effectively introduce new products to Canada. Some firms that are new to selling to Canada prefer to sell directly to the Canadian end-user and provide service from their U.S. headquarters.

Canada and the United States have a long history of co-operative and lucrative trade. Both countries are members of the North American Free Trade Agreement (NAFTA) and there are no significant barriers to trade for the importation of photonics products.

Detailed information to market access into Canada can be found on the following websites:

Industry Canada: [www.ic.gc.ca](http://www.ic.gc.ca)

Foreign Affairs and International Trade Canada: [www.international.gc.ca](http://www.international.gc.ca)

## **Market Issues & Obstacles**

### **Tariffs and Levies**

Under the North American Free Trade Agreement (NAFTA), no customs duties or tariffs are levied on qualified U.S.-made products entering Canada. To get duty-free status under the NAFTA rules of origin, a commercial NAFTA import over \$1,600 must be accompanied by a NAFTA Certificate of Origin, while a commercial import less than \$1,600 only requires a statement of origin from the exporter that the product is U.S.-made. Canada looks at the origins of the component parts of an item and whether they are transformed in the process of manufacture into another category to determine whether a product is entitled to NAFTA treatment. This can be quite complex; therefore, U.S. companies should consult the U.S. Department of Commerce's NAFTA Certificate of Origin Interactive Tool at <http://web.ita.doc.gov/ticwebsite/ticit.nsf/>.

## Taxes

The Canadian Goods and Services tax (GST) of five percent on a value-added basis is assessed by [Revenue Canada](#) at the time of import, and at each subsequent resale level. Importers are entitled to partially offset their GST payments by collecting and retaining GST payments received from their customers.

## Standards Certification

All electrically powered products sold in Canada must comply with the standards established by the [Canadian Standards Association \(CSA\)](#), Canada's largest standard-writing body. Information pertaining to these standards can be obtained by contacting the CSA directly. According to the [Canadian Radiocommunication Act](#) and the [Radiocommunication Regulations](#), in addition to CSA requirements, wireless telecommunications equipment imported into Canada must also be certified by Industry Canada.

Industry Canada's equipment certification requirements for wireless telephones are covered by several existing [Radio Standards Specification \(RSS\) regulations](#). U.S. companies should contact Industry Canada to determine the appropriate equipment certification requirements for their particular products.

## Labeling Requirements

The GOC's Consumer Packaging and Labeling Act requires consumer product packaging to be in both official languages, English and French. In addition to federal labeling requirements in Canada, the Province of Quebec has additional French-language requirements. For example, directions for use and warranty certificates accompanying the product must be provided in the French language. The province also requires that any French labeling/markings must be given at least equal prominence as labeling/markings in any other language(s) on packaging. For further information on language requirements for the province of Quebec, contact the Office québécois de la langue française at <http://www.oqlf.gouv.qc.ca/english/charter/index.html>. Exporters are encouraged to work with a local distributor or major retailers to meet these requirements and ensure proper French-Canadian language usage.

## Trade Events

### [Advances in Photonics Fabrication Workshop](#)

March 5, 2009  
Ottawa, ON

### [CLAN Workshop](#)

March 11-12, 2009  
Toronto, ON

### [Photonics North 2009](#)

May 24-27, 2009  
Quebec City, Quebec

### [Frontiers in Neurophotonics](#)

June 1-10, 2009  
Quebec City, QC

### [HARMST 2009](#)

8<sup>th</sup> International Workshop on High Aspect Ratio Micro Structure Technology  
June 25-28, 2009

### [WIRMS 2009](#)

5<sup>th</sup> International Workshop on Infrared Microscopy and Spectroscopy with Accelerator Based Sources



September 14-17, 2009  
Banff, AB

[Electrical Power & Energy Conference 2009](#)

October 22-23, 2009  
Montreal, QC

## Resources & Contacts

### Photonics Associations:

Canadian Photonics Consortium – [www.photonics.ca](http://www.photonics.ca)  
Ottawa Photonics Cluster – [www.ottawaphotonics.com](http://www.ottawaphotonics.com)  
Quebec Photonic Network - <http://www.quebecphotonic.ca>  
Ontario Photonics Technology Industry Cluster (OPTIC) - <http://www.optic.on.ca>

### Research Institutes:

Canadian Institute for Photonics Innovations (CIPI) - <http://www.cipi.ulaval.ca>  
CMC Microsystem - <http://www.cmc.ca/index.htm>  
Ontario Centre of Excellence for Photonics - [www.oce-ontario.org/Pages/COEPhotonics.aspx?COE=PH](http://www.oce-ontario.org/Pages/COEPhotonics.aspx?COE=PH)  
Fonds Québécois de la recherches sur la nature et les technologies (FQRNT) - [www.fqrnt.gouv.qc.ca](http://www.fqrnt.gouv.qc.ca)

### Government Research Institutes:

National Research Council of Canada – <http://www.nrc-cnrc.gc.ca>  
Canadian Photonics Fabrication Centre (CPFC) - [http://cpfc-ccfdp.nrc-cnrc.gc.ca/home\\_e.html](http://cpfc-ccfdp.nrc-cnrc.gc.ca/home_e.html)  
Communications Research Centre (CRC) - <http://crc.ca/>  
Institut national d'optique (INO) – [http://www.ino.ca/index\\_en.aspx](http://www.ino.ca/index_en.aspx)  
Canadian Light Source (CLS) - <http://www.lightsource.ca/>  
Advanced Laser Light Source - <http://lmn.emt.inrs.ca/EN/ALLS.htm>  
Canadian Advanced Network and Research for Industry and Education (CANARIE) - <http://www.canarie.ca/>  
Defence Research and Development Canada - <http://www.drdc-rddc.gc.ca>

## For More Information

The U.S. Commercial Service in Ottawa, Canada can be contacted via e-mail at: [Tracey.Ford@mail.doc.gov](mailto:Tracey.Ford@mail.doc.gov);  
Phone: 613-688-5406; Fax: 613-238-5999; or visit our website: [www.buyusa.gov/canada](http://www.buyusa.gov/canada).

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